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ABSTRACT

While 1990 was the year of reform recommendations in mathematics education, 1991 may become the year of assessment in mathematics education. The growth of assessment activities stems from the belief that the primary purpose of assessment is the improvement of teaching. The digest reviews trends in mathematics assessment. Discussed are the sudden emphasis on assessment; how schools can improve their methods of assessing students; how assessment can be used to improve instruction; what changes are taking place in state testing programs; what is happening in college entrance examinations programs; what is happening in assessment at the national level; and what schools can do to improve themselves. A list of 11 selected references is included. (CW)

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SELECTED PROCEDURES FOR IMPROVING THE MATHEMATICS CURRICULUM: ASSESSMENT

While 1989 was the year of reform recommendations in school mathematics with release of the Mathematical Sciences Education Boards' (MSEB) *Everybody Counts* and the National Council of Teachers of Mathematics' (NCTM) *Curriculum and Evaluation Standards for School Mathematics*, 1991 is shaping up as the year of assessment in mathematics education. This focus is highlighted by the MSEB National Summit on Mathematics Assessment to be held in Washington, DC on April 24, and the release of the National Assessment of Educational Progress (NAEP) 1990 Mathematics Assessment in Washington, DC on June 6. Included in the 1990 NAEP results is a comparative study of the mathematical achievement of students in 37 states, the District of Columbia, Guam, and the Virgin Islands.

Why the sudden emphasis on assessment?

The growth of assessment activities in mathematics results from the overall emphasis on reform in mathematics, the specific recommendations in the *Standards*, and, in some cases, increased calls for accountability. Both NCTM and MSEB's efforts to highlight assessment stem from the belief that the primary purpose of assessment is the improvement of teaching. This focus changes the emphasis from testing to broader forms of assessing student growth in mathematical skills and knowledge. The *Standards* called for schools to 1) enlarge the number of methods employed in assessing student achievement and disposition; 2) make student assessment directly tied to teaching improvement, 3) ensure that all aspects of the curriculum and its connections be assessed; and 4) instruction and curriculum be equally valued in any evaluation of a school program in mathematics.

How can a school improve its methods of assessing students?

The first step that a school can take in improving its assessment program is to evaluate the relationship of the program to the stated goals of the curriculum and the classroom activities used to reach those goals. Simple coverage of the goals is not enough. Do test items reflect the cognitive goals espoused? What is being done to measure students' growth in problem solving, in communicating, in reasoning, and in making connections?

Methods of assessment that should be included in assessing student performance include the evaluation of student products (portfolios, writing samples, investigations—individual or group, and traditional assessment results), performances (observations, interviews, student questions), student self assessment, and ability to employ technology in mathematics related settings. The employment of broader, product-related assessment methods moves the measurement of student abilities close to "real-world" activities. They allow for the measurement of students' ability to understand situations, to model mathematics in the situations, to select and apply problem solving heuristics, and communicate the results of their investigations. These methods also allow the assessment of what a student can do when time, materials, references, and access to technology and peers are not barriers to the evaluation process.

The addition of these new methods of evaluating students will require a great deal of faculty development. School districts should be preparing and implementing programs of faculty development in assessment. Teachers need assistance in evaluating student responses to higher-order problem solving questions, to grading written communications, and to observing students' individual and small group contributions. In particular, mathematics teachers need exposure to the holistic and analytic approaches used by language arts teachers in assessing students' written work.

How can assessment be used to improve instruction?

If the assessment results for students are to have any effect on the instructional program, schools must see that their teacher evaluation program is designed to collect relevant information on teaching, provide for its analysis, and its use in altering instruction to achieve the program goals. The NCTM's *Professional Standards for Teaching Mathematics* (in press) provides strong guidance on how to implement ties between student assessment and program evaluation and teacher evaluation and faculty development.

These teaching standards recommend the establishment of a regular evaluation cycle that involves the teaching staff in gathering data, peer analyses of teaching acts, and related faculty development building on teacher needs. The stress in these recommendations is for an increased teacher role in teacher evaluation and teaching improvement. Teachers, like students, should be evaluated across a broad range of activities including lesson plans, portfolios of student products and lesson materials, teaching different subjects, teaching different levels of students, and teachers' own self analyses of their teaching. These evaluations, like those of students, should focus on the attainment of objectives dealing with setting a solid context for learning; achieving the process objectives of problem solving reasoning, communication, and the establishment of connections; and improving students' dispositions toward mathematics.

What changes are taking place in state testing programs?

Many of the state assessments are working to change the nature of their testing programs. Several (Missouri, Connecticut, Michigan) have begun to allow student use of calculators during testing. California has experimented with open-ended problem solving situations. Illinois has developed a broad range assessment and reports school-level results in seven areas of mathematics related to the *Standards*.

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Vermont has taken the largest step in instituting a portfolio evaluation process as a portion of its state assessment at grades four and eight. Initial plans were for teacher evaluators to examine most student portfolios for their best piece of work and sample other portfolios for a measure of the breadth of work taking place in a given locale. The state department of education is providing inservice education for a number of teachers to employ a Likert-like rating scale to assess the contents of individual portfolios. Many other states are moving to alter the nature of their state assessments to accommodate the broader view of mathematics represented in the *Standards*.

What is happening in college entrance examination programs?

To accommodate the changes in school mathematics, the American College Testing Program (ACT) and the College Board's Scholastic Aptitude Test (SAT) have each instituted changes in their assessment of students. The ACT has altered its mix of items to provide for the reporting of an overall mathematics scale score as well as subscores in the ares of prealgebra/elementary algebra, algebra/coordinate geometry, and plane geometry/trigonometry. These changes were directed toward assisting in the placement process at the collegiate level and providing a broader range of feedback to the students' schools.

The College Board announced in late 1990 that it would begin to allow the use of the hand calculator on the SAT starting with the Spring, 1994 administration of the examination. A form of the Level II Achievement test requiring the use of the calculator will be available in June, 1991. Besides the addition of calculator active items, the SAT will also employ a response grid that allows for the use of open-ended questions where a student may respond with either a decimal or rational answer.

These changes were made in an attempt to make the examinations more responsive to changes in curricula and in assessment methods. At the same time, considerable discussion continues about the worth of the use of such tests and their potential for placing a damper on change in school mathematics. Other discussions have dealt with the lack of change in assessment or placement policies at the university level as contributing to the reluctance of secondary schools to change their policies of assessment.

What is happening in assessment at the national level?

Assessment is one of the hottest issues in policy discussions at the national level. Many argue that current tests do not measure the mathematics that business leaders and educators believe students should know, that tests are not matched with the goals for educational reform, and the current press for accountability has increased the stakes in testing which, in turn, leads to the possible inhibition of curricular reform. The MSEB Summit on Mathematics Assessment will focus on establishing principles that will 1) develop tests and assessments that are in line with the knowledge, procedures, skills, and dispositions found in the *Standards*, 2) develop guidelines for judging the quality of a mathematics test or assessment, 3) increase the research efforts associated with assessment related questions in mathematics education, 4) develop methods for holding schools accountable for meeting the national goals for mathematics achievement in an atmosphere that supports the *Standards*, and 5) work to ensure public understanding of the assessment of a broad range of mathematics achievement. These recommendations are being made against a backdrop where the reporting of states' performance on the 1990 NAEP trail-state-assessment will bring mathematics assessment results to a pinnacle in high-stakes assessment.

What can schools do?

Each administrator and teacher involved with school mathematics programs should begin immediately to become informed about alternatives in assessment for school mathematics. They should then arrange for faculty development programs to initiate some of the recommended changes in their school programs consistent with changes in their school mathematics program. Concurrent with the changes, they should provide a venue for public discussion of the changes in the curriculum, the assessment of students, and report the results of their initial activities. Changes should also be planned for concomitant changes in the evaluation of teachers consistent with the NCTM recommendations to see that the results of the student assessments and teacher evaluations are used to improve instruction in the schools' mathematics programs.

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